

# An avian outbreak associated with panzootic equine influenza in 1872: an early example of highly pathogenic avian influenza?

David M. Morens, Jeffery K. Taubenberger

National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD, USA.

Correspondence: David Morens, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD 20892, USA.

E-mail: dm270q@nih.gov

Accepted 15 August 2010. Published Online 12 October 2010.

**Background** An explosive fatal epizootic in poultry, prairie chickens, turkeys, ducks and geese, occurred over much of the populated United States between 15 November and 15 December 1872. To our knowledge the scientific literature contains no mention of the nationwide 1872 poultry outbreak.

**Objective** To understand avian influenza in a historical context.

**Results** The epizootic progressed in temporal-geographic association with a well-reported panzootic of equine influenza that had begun in Canada during the last few days of September 1872. The 1872 avian epizootic was universally attributed at the time to equine influenza, a disease then of unknown etiology but widely

believed to be caused by the same transmissible respiratory agent that caused human influenza.

**Conclusions** Another microbial agent could have caused the avian outbreak; however, its strong temporal and geographic association with the equine panzootic, and its clinical and epidemiologic features, are most consistent with highly pathogenic avian influenza. The avian epizootic could thus have been an early instance of highly pathogenic avian influenza.

**Keywords** Avian influenza, epizootic, equine influenza, highly pathogenic avian influenza, influenza poultry.

Please cite this paper as: Morens and Taubenberger (2010) An avian outbreak associated with panzootic equine influenza in 1872: an early example of highly pathogenic avian influenza? *Influenza and Other Respiratory Viruses* 4(6), 373–377.

## Introduction

An explosive fatal epizootic in poultry, prairie chickens, turkeys, ducks, and geese occurred over much of the populated United States between November 15 and December 15, 1872. The epizootic progressed in temporal-geographic association with a well-reported panzootic of equine influenza, which had begun in or around Markham, Ontario, during the last few days of September 1872,<sup>1–4</sup> at a time when human influenza had not been recently prevalent.

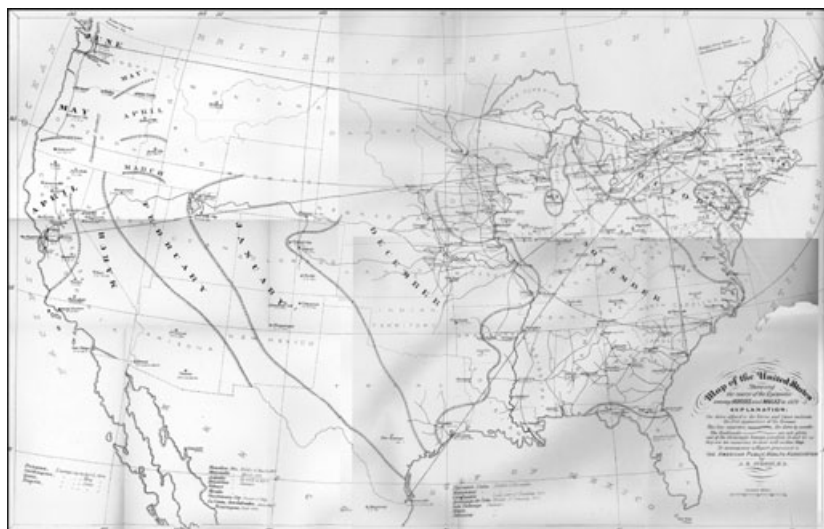
The equine epizootic spread rapidly into the United States along railroad lines, with separate simultaneous introductions into Michigan and upper New York State. It quickly spread over the entire United States to the Caribbean and Central America (Figure 1). Horses, mules, and menagerie/circus zebras were involved, with “spill over” infections into dogs and cats.<sup>4</sup>

Numerous individual human cases and localized outbreaks throughout the United States, often associated with exposures to ill horses, were reported. The human dis-

ease, generally mild and uncomplicated, was popularly referred to as the “epizooty”, or “zooty”.<sup>4</sup> Major US influenza epidemics were documented in 1873 and 1874,<sup>5</sup> but it is not clear that they were related to the 1872 panzootic. The panzootic proceeded explosively and extinguished rapidly, but smaller outbreaks recurred in some locales in late winter and early spring 1872–1873, and episodically in years thereafter.<sup>1,2</sup> Major national epizootics of equine influenza recurred in 1880–1881, 1900–1901, and 1915–1916,<sup>4</sup> but avian epizootics were not to our knowledge associated with them.

## Methods

Information about the 1872 avian epizootic was identified by systematic web-based examination of 89 newspapers published in 22 of the 37 States and two of the 12 Territories (Colorado and Utah), representing approximately 70·4% of the US population, and covering the period from January 1, 1872 to June 30, 1873. Using various keyword



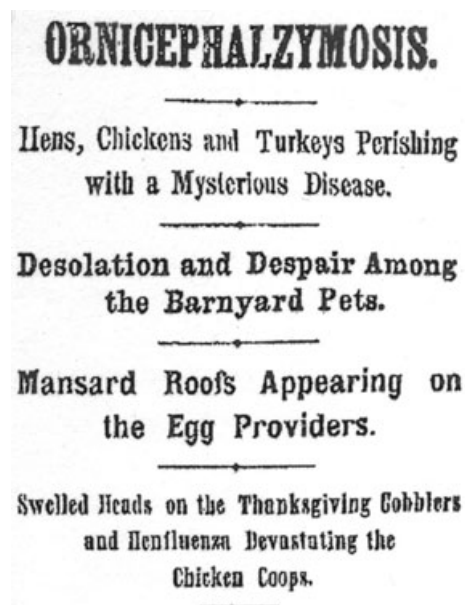
**Figure 1.** Adonirum B. Judson's map of the equine panzootic as it occurred in Canada and the United States, 1872–1873,<sup>1</sup> showing progressive dates of outward expansion from the point of origin near Markham, Canada, in late September 1872, to its detection in Washington State in May 1873.

combinations (e.g., “chicken epizootic”, “chicken disease”, “fowl disease”, and others), we searched two web-based newspaper archival sources (<http://www.Newspaperarchives.com>; <http://www.Proquest.com>) with optical character recognition (OCR) capability, visually scanned the OCR summaries for each of over 3200 “hits”, and then examined, printed, and read newspaper pages containing relevant information.

## Results

Lethal outbreaks in domestic chicken flocks associated with the equine panzootic were first reported in Poughkeepsie, New York, on November 15, 1872.<sup>6</sup> Newspapers generally referred to the epizootic as “the chicken disease”, but many different names, some of them fanciful or humorous, were used in different parts of the country, including *chicken epidemic* [sic], *chicken epihippic* [sic; *epihippic* being a less common term for epizootic equine influenza], *chickizooty*, *epiornithosis*, *henfluenza*, *ornicephalzymosis*, and many others (Figure 2<sup>7</sup>). In some Pennsylvania locales with large German-speaking populations, the avian epizootic disease became known as *Pferdhühnkrankheit* (“horse-chicken-disease”<sup>8</sup>).

Whole flocks were usually struck simultaneously, with fatality at or near 100%. Prominent features included upper respiratory signs of “a cold or influenza”, slimy discharge emitted from the beak, dark streaks in the neck, “dizziness” or “staggering fits”, crawling away from the flock into holes or corners, and death within 12–18 hours.<sup>9–12</sup> In many cases, the head swelled markedly before death, prompting poultry vendors to decapitate ill birds and rush them into city markets for sale.<sup>10,11</sup> Suspicious buyers



**Figure 2.** *New York Herald* headline (Monday, November 18, 1872, page 3, column 6), reporting outbreaks of fatal avian disease in birds brought from surrounding areas into New York City and elsewhere.<sup>30</sup> It was universally believed that the avian disease, often referred to as “henfluenza”, as it is here, was being transmitted to poultry from horses ill with equine influenza. The term “fatal epizootic” refers to equine influenza, which during the 1872–1873 panzootic was more often called “the epizootic” or “the epizooty” when seen in horses, mules, or humans. The reference to “mansard [Mansart] roofs” appears to be a pun related to the “great” Boston fire 10 days earlier, in which a large part of the city burned to the ground.<sup>7</sup> The press blamed not only horse-less fire department wagons, pulled by teams of human volunteers, for responding too slowly, but also alleged poor fire repellant properties of new mansard roofs on storehouses that first caught fire.

**Table 1.** Dates of first identified newspaper reports, for 11 States/jurisdictions, of onset of equine influenza (column 2) and avian influenza (column 3) 1872

Place of occurrence	Equine epizootic onset reported	Avian epizootic onset reported	Interval in days
New York City	October 20	November 18	29
Massachusetts	October 22	November 17	26
Rhode Island	October 23	November 21	29
Hudson Valley	October 25	November 15	21
Northern Pennsylvania	October 28	November 18	21
New Jersey	October 29	November 19	21
Illinois	October 29	December 7	39
Iowa	November 4	November 28	24
Wisconsin	November 4	December 10	36
Indiana	November 17	November 28 (chickens)	11
		December 27 (prairie chickens)	25
Missouri	December 2	December 2	0

and newspaper reporters noted that recently ill birds could be detected by swollen heads or recent decapitation (not normally a practice in poultry markets), neck discoloration and dark breast flesh.<sup>9</sup>

From the upper Hudson River area of New York State, the epizootic expanded rapidly outward, allegedly “following in the tracks of the dread [equine] Epizootic” (Figure 2; Table 1<sup>9</sup>). Evidence of the avian epizootic was found in nine of 22 States in which we sought newspaper evidence and was concentrated in the Northeast and Midwest. Newspaper reports indicate a strong temporal-geographic association between the equine panzootic and the avian epizootics (Figure 2; Table 1). Based on the examination of over 3200 reports, all poultry epizootic activity occurred in locales that were having, or had had within the previous 1–2 weeks, widespread panzootic equine influenza. Local observers repeatedly linked avian disease to antecedent equine disease and independently noted outbreaks in poultry immediately after being allowed to peck in stables that held ill or recently ill horses.<sup>13,14</sup>

Outbreaks of an allegedly novel fatal swine disease were also widely reported and often attributed to pigs rooting in stables after equine illnesses.<sup>14–16</sup> Unfortunately, clinical signs and epidemiological features of this disease were poorly described and not distinguishable from swine fever.<sup>12,14</sup> Reports of morbidity and moderate mortality in wild deer around the country were also attributed by observers to equine influenza on the basis of clinical signs and development of illness after contact with ill work horses in the forests.<sup>17–21</sup>

## Discussion

The 1872 avian epizootic raises difficult questions. It is impossible to identify with certainty any of the diseases in horses, humans, poultry, pigs, or deer, as materials for “archaemicrobial” testing have not been identified. The equine and human diseases were regarded at the time to be clinically and epidemiologically typical of influenza. A close association between equine and human influenza had been extensively documented since 1648, with equine outbreaks typically preceding, or less frequently following epidemics by a few weeks.<sup>2,4</sup> The 1872 avian epizootic was universally attributed to equine influenza, a disease then of unknown etiology but widely believed to be caused by the same transmissible respiratory agent that caused human influenza.

The avian disease could have been caused by other agents; however, the strong temporal and geographic association with equine influenza and its clinical and epidemiologic features are highly consistent with influenza, and specifically highly pathogenic avian influenza (HPAI), as the cause of poultry disease. Newcastle disease was not recognized until 1926, and the epizootic features described in 1872 seem less consistent with it than with HPAI. Newcastle disease does not seriously affect horses, pigs, or humans. The associated diseases in swine and deer are curious, but in both cases, the link to equine disease is more tenuous and neither disease was described clearly in newspaper reports. Repeated observations that pigs, like chickens, became ill after rooting in stables where ill horses had been, or were being kept, could be coincidental and were in any case repeated in reports that were passed around from newspaper to newspaper. Swine influenza was not recognized until 1918 and there is little evidence of which we are aware that it existed in the preceding decades.<sup>4</sup> Influenza in deer has been reported only rarely.<sup>4</sup>

Wild avian species constitute a reservoir for influenza A viruses, which can be transmitted to domestic gallinaceous poultry (chickens, turkeys, quail, etc.) and to mammals (humans, pigs, horses, and other species). Back-transmission from mammals to birds is apparently not common, although turkey outbreaks of swine-adapted influenza viruses, including the 2009 pandemic virus, are well described.<sup>4</sup> The first equine influenza virus to have been isolated (now presumed extinct) was a 1956 H7N7 subtype virus,<sup>4</sup> as were all known HPAI viruses from the early 20th century. Curiously, the available equine H7N7 hemagglutinin sequences contain an expanded cleavage site as do HPAI H7 viruses. It is not known when these virus lineages appeared or whether they are descendants of 19th century avian or equine viruses. If the 1872 epizootic was truly caused by an avian HPAI virus that was coadapted to horses, the unprecedented epizootic features remain to be explained.

The equine panzootic clearly spread from city to city between railroad hubs, in a manner analogous to modern airline hub-associated spread of diseases like pandemic acute hemorrhagic conjunctivitis (1981), SARS (2003), and the novel 2009 H1N1 virus. One speculative possibility is that the equine panzootic could have begun in Ontario with avian to equine viral transmission and have been subsequently amplified and spread by the large and mobile horse population. In this scenario, equine disease caused by a newly equine-adapted but still avian-like HPAI virus was carried by ill horses and then “back-transmitted” into local poultry farms everywhere horses were shipped, horses thereby serving as intermediate hosts for avian transmission. Such a mechanism of spread, though speculative, is consistent with the nature of the poultry industry of the era, confined largely to small farms with few free-ranging chickens, and with limited transportation of poultry, mostly from farms into urban markets.

Alternatively, the avian epizootic might have been spread entirely by the movement of poultry. This appears consistent with the rapidity of recognition of the outbreaks, identified west of the Mississippi River within a week of initial reports in upper New York, a travel time that seems possible only by railroad, and with most recognized outbreaks occurring in the vicinity (100 or so miles) of rail lines. However, we have little information about the extent of large-scale poultry rail shipment in that era, which in any case went generally from West to East,<sup>22</sup> in the opposite direction of equine and avian epizootic spread. Conceivably, the apparent rapidity of spread of the avian epizootic merely reflected “epidemic recognition”, once major newspapers picked up the story. A final possibility that the avian epizootic was a ruse perpetrated by butchers attempting to co-opt pre-thanksgiving poultry sales – a widely circulated charge made by poultry sellers and at least one reporter – seems at variance with the many independent reports from around the country, and with the signs and epizootiologic features described. Nevertheless, evaluating newspaper reports of the era is complicated by reporting whose accuracy cannot be independently assessed, copying of stories, and possibly embellishment for local consumption.

To our knowledge, the scientific literature contains no mention of the nationwide 1872 poultry outbreak. This may be because at the time, there was no organized poultry industry, chickens being generally raised on small farms by farmers or farm wives, and because physicians and veterinarians rarely examined or treated poultry. Fowl plague (later recognized as HPAI) was not described until 1878, and swine influenza was not described until 1918.<sup>23–25</sup>

Lacking scientific publications on the avian epizootic, web-based newspaper analysis was uniquely helpful in obtaining information about explosive nationwide spread of

the epizootic diseases and provided significant advantages over traditional historical investigation into disease outbreaks utilizing library-based published sources and (typically non-centralized) archival and primary data sources. Indeed, comparison of newspaper-reported dates and locations of equine influenza appearance with scientific data published in 1873 New York public health physician Adoniram Judson,<sup>1,3</sup> and in 1874 by Ithaca, New York-based veterinary professor James Law,<sup>2</sup> both of whom had access to selected newspapers and probably telegraph dispatches, suggests greater accuracy and comprehensiveness in the web-based newspaper research. Negative aspects of the newspaper sources include lack of scientific detail, hearsay evidence, and republishing or copying of stories.

In an exhaustive historical search completed in the 1880s and covering millennia, Fleming found no avian outbreaks that seem to us consistent with HPAI.<sup>26,27</sup> If the 1872 poultry epizootic was caused by influenza, it would be the first such epizootic identified. Observers in 1872 suggested that the same poultry disease had been spread throughout the United States about 5 years earlier, apparently with much less explosiveness.<sup>28</sup> Other consistent outbreaks were documented much earlier, e.g., an avian outbreak widespread in Northern Italy in the summer of 1789.<sup>29</sup> Despite the negative evidence of Fleming and others, it seems plausible to us that avian influenza could have existed for centuries without detection.<sup>4</sup> To better understand human influenza, which has been repeatedly pandemic over at least 500 years, it may be fruitful to examine non-traditional historical sources, such as equine, poultry, and agricultural records. Such efforts may help us learn more about the behavior of influenza, which is caused by a complex group of wild avian viruses with the ability to adapt to a variety of domestic avian and mammalian hosts and environmental milieux.<sup>4</sup>

## Acknowledgement

This work was supported by the Intramural Research Program of the NIH and the NIAID.

## References

- 1 Judson A. Report on the origin and progress of the epizootic among horses in 1872, with a table of mortality in New York. Illustrated with maps; in York Board of Health of the City of New York (ed.): Third Annual Report of the Board of Health of the Health Department of the City of New York April 11, 1872, to April 30, 1873. New York: D. Appleton and Company; 1873; 250–291.
- 2 Law J. Influenza in horses. in Commission of Agriculture (ed.): Report of the Commissioner of Agriculture for the Year 1872. Washington, DC: Government Printing Office; 1874; 203–248.
- 3 Judson A. History and course of the epizootic among horses upon the North American continent in 1872–1873. Public Health Pap Rep [American Public Health Association]. 1873;1:88–109.

- 4 Morens DM, Taubenberger JK. Historical thoughts on influenza viral ecosystems, or Behold A Pale Horse, dead dogs, failing fowl, and sick swine. *Influenza Other Respi Viruses* 2010. E-pub. 4 August 2010.
- 5 Tyrrell G. The epidemic influenza. *Pacific Med Surg J.* 1873;6:213–225.
- 6 Anonymous. An epidemic among Barn-Yard Fowl. *NY Times.* 16 November 1872.
- 7 Anonymous. Devastation! Boston. 11 November 1872.
- 8 Anonymous. Pferdhuhnkrankheit. The Janesville [Wisconsin] Gazette. 22 November 1872.
- 9 Anonymous. Unhappy Hendom. The [New York] World. 17 November 1872.
- 10 Anonymous. The epizootic among the chickens. *Chicago Daily Tribune.* 18 November 1872.
- 11 Anonymous. The epizootic among the poultry. The Iowa State Reporter. 20 November 1872.
- 12 Anonymous. Epihippo notes. The [Port Jervis, New York] Evening Gazette. 21 November 1872.
- 13 Anonymous. The poultry disease. The [New York] Herald. 19 November 1872.
- 14 Anonymous. Ohio: heavy robbery – serious railway accident - the epizootic killing hogs and chickens. The [Davenport, Iowa] Daily Gazette. 28 November 1872.
- 15 Anonymous. The Chickizooty-Rootizooty, &c. The Dubuque Herald. 1872.
- 16 Anonymous. Chickens and hogs diseased about stables where sick horses were kept. *NY Times.* 28 November 1872.
- 17 Anonymous. The deer dying in the woods of Michigan. *NY Times.* 13 November 1872.
- 18 Anonymous. General news items. *Chicago Daily Tribune.* 16 November 1872.
- 19 Anonymous. Untitled. The [New York] World. 17 November 1872.
- 20 Anonymous. A disease among the deer family. The [Baltimore] Sun. 21 November 1872.
- 21 Anonymous. In general. The Hartford Daily Courant. 26 November 1872.
- 22 Anonymous. The poultry trade. Where poultry come from – extent of the market – the prospects for the season – effects of the poultry disease. *NY Times.* 17 November 1872.
- 23 Perroncito E. Epizootia tifoide nei gallinacei. *Ann Accad Agric (Torino)* 1878; 21:87–126.
- 24 Taubenberger JK, Hultin JV, Morens DM. Discovery and characterization of the 1918 pandemic influenza virus in historical context. *Antivir Ther* 2007; 12(4 Pt B):581–591.
- 25 Taubenberger J, Morens D. Pandemic influenza – including a risk assessment of H5N1. *Rev Sci Tech.* 2009;28:187–202.
- 26 Fleming G. *Animal Plagues: Their History, Nature, and Prevention.* London: Chapman and Hall, 1871.
- 27 Fleming G. *Animal Plagues: Their History, Nature, and Prevention, Vol. II. (From A. D. 1800–1844).* London: Baillière, Tindall, and Cox, 1882.
- 28 Anonymous. The poultry trade. The Richwood [Ohio] Gazette. 5 December 1872.
- 29 Baronio G. Essai sur la maladie épizootique qui a régné sur les volailles, dans la Lombardie, pendant l'été de 1789; in Chabert [P], Flandrin [P], Huzard [J-B] (eds): *Instructions et observations sur les maladies des animaux domestiques.* Tome IV. Deuxième ed. Paris: Huzard; An X [1802]; 207–225.
- 30 Anonymous. Ornicephalzymosis. The New York Herald. 18 November 1872.